Development of Machine Learning Based Security Model for IoT Network

MALIK JAWARNEH

Faculty of Computing Sciences, Gulf College

Abstract- IoT allows the worldwide concept of intelligent cities. Smart homes, intelligent agriculture, intelligent environment, intelligent health, smart governance etc are all types of smart cities. In addition, IoT is also used in industries such as petroleum mining, gas mining, and production units. IOT boosts productivity, optimizes costs, optimizes human resources, forecasts maintenance and offers human life a lot of comfort. With more and more heterogeneous devices and data processing, security concerns are increasing. The main reasons for preventing IoT from flourishing are security and privacy issues. We will develop a machine learning based model to detect and predict vulnerabilities. This will be implemented in Java. We will also propose a block chain based security model, which will be a comprehensive mitigation plan for various vulnerabilities. Existing mitigation plans discuss about a particular vulnerability or attack. But our proposed model will cover maximum possible vulnerabilities.

Indexed Terms- Internet of Things (IoT), Vulnerability, Threat, Attack, Mitigation Plan

I. INTRODUCTION

Industrial revolution occurred before 200 years prior, to expand the efficiency, which prompts quicken the economy. When mechanical forces replaced human and creature muscle power. Internet came into existence in 1950, which relies upon networking and communication so as to expand the efficiency and supported worldwide economy obviously superior to mechanical upset. The next revolution that will drive another string to build the productivity is Internet of Things (IoT). Haller defined IoT as: "A world where physical objects are seamlessly integrated into the information network and where the physical objects can become active participants in the business process". [1-12]. The exceptionally quick development of Internet-associated gadgets, extending from basic sensors to cloud servers, has created the paradigm the Internet of Things. The closeness between all IoT objects is the capacity to associate with the Internet and trade information. The system availability highlight permits controlling articles remotely over the current system foundation, bringing about more incorporation with this present reality and less human intercession.

The IoT changes objects from being ancient to smart by applying its basic advances, for example, pervasive computing, correspondence capacities, Internet conventions, and applications [13-33]. Consolidating things with sensors, hardware, and connectors made them more intelligent and getting increasingly open to us, which bring about better human lives, offer more accommodation, wellbeing, security, and proficient use of characteristic assets.
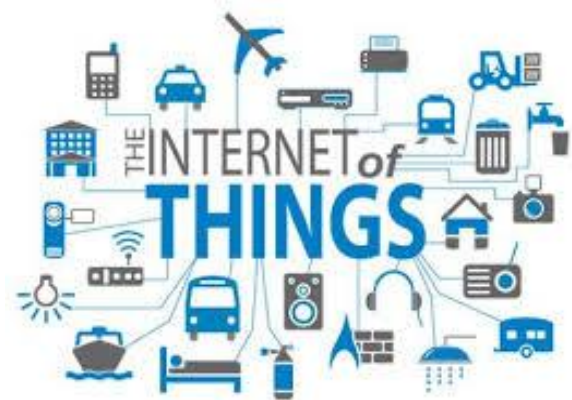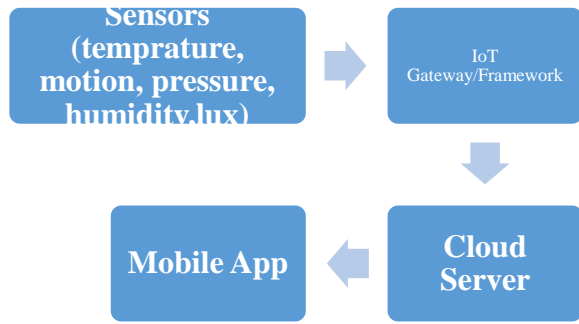

Figure 1: Internet of Things [IoT]

Figure 2: Basic building Blocks of IoT

In above figure 2, Sensors are a lot of diodes equipped for detecting natural physical boundaries, for example, temperature, pressure .Sensors are responsible for acquisition of data. They can be configured to collect data continuously. Sensors are capable of capturing humidity, temperature, motion and many more. IoT platform is a middleware. Many quality IoT platforms are available now a day's such as- Microsoft Azure IoT and AWA IoT. Actual data is stored in cloud server. In cloud, data analytics applications are applied and relevant data is shared with stakeholders using mobile applications[34-54].

II. RESEARCH BACKGROUND AND RELATED WORK

This section presented the related work for machine learning and Blockchain as follows:

2.1 Machine Learning (Ml)

Machine Learning could be considered a development from AI since it mixes AI heuristics with cutting edge measurable investigation. AI endeavors to let PC programs find out about the information they study, with the end goal that projects settle on various choices dependent on the qualities of the contemplated information, utilizing measurements for major ideas, and including further developed AI heuristics and calculations to accomplish its objectives. Information mining is best portrayed as the association of recorded and late improvements in measurements, AI, what's more, AI. These strategies are utilized together to examine information and find recently concealed patterns or examples inside. Information mining is finding expanding acknowledgment in science and business

regions that need to dissect a lot of information to find slants that they couldn't in any case find. Classification algorithms can be found at the heart of a great number of machine learning tasks. Classification can be applied to all data types, whether simple or complex, like numerical, nominal, categorical, boolean, trees, time series and graphs etc. The process of classifying comes under the predictive method [55-65].

2.2 Blockchain

A block chain [5] is a decentralized, passed on and opens mechanized record that is used to record trades transversely over various PCs so any included record can't be balanced retroactively, without the difference in all resulting blocks. This empowers the individuals to affirm and audit trades self-sufficiently and tolerably monetarily. A block chain database is supervised freely using a common framework and an appropriated time-venturing worker. They are confirmed by mass collaboration powered by total individual issues. Such an arrangement empowers vivacious work process where individuals' weakness regarding data security is fringe. The use of a block chain empties the typical for unfathomable reproducibility from a propelled asset.

Block chains are utilized to improve the account and sharing of budgetary exchange data, which can be found as far as sped up, diminished procedural cost, less exchange blunders, expanded general security, and a decentralized methodology [77-85] . This decentralized technique expels a main issue of framework disappointment and weakness to cyber attacks. The primary thought behind block chain utilization in virtual budgetary exchanges is that the wallet of every client isn't halfway spared; rather, it is made sure about by putting away the record of exchanges between clients in a block chain.

Arsalon Mohsen Nia et al., 2016[89-101] gives an inside and out examination of potential assaults and weaknesses. Mohamed Abomhara et al., 2014 [102-105] gave security dangers and difficulties in Internet of Things. They likewise tended to that there are four interconnected segments, in particular individuals, article, equipment and programming, which speaks with one another over untrusted private system. Cart [106-110] gave an insightful and inside and out

investigation of future problems in IoT. Salim ELBOUANANI [111-125] demonstrated that there is at present no norm or system which covers all security perspectives in the Internet of Things. They found that confirmation is a genuine test in IoT.

Krishna Kanth Gupta et al., 2016 [126-130] anticipated that there will be 25 billion IoT gadgets by 2020. They likewise recognized difficulties in Internet of Things. Gurpreet Singh Matharu et al., 2014 explained that interoperability; normalization and security are the regions which require a ton of examination so web of things can flourish. HuiSuo et al.,2012 introduced encryption based methodology to enhance security features in IoT solutions. C. Flügel et al.,2009 [131-135] introduced a review over a portion of the specialized provokes that should be defeated to assemble such system. L. Atzori et al.,2012 promoted the idea of using IoT in social platforms.

IEEE range 2014 established java as the prominent design tool for IoT solutions. World financial gathering modern web overview, 2014 set up a more clear comprehension of the extraordinary chances and new dangers emerging from the Industrial Internet. Hammi et al.,2018 proposed a unique decentralized framework called air pockets of trust, which guarantees a powerful recognizable proof and verification of gadgets. Authors in proposed different block chain based solutions for IoT ecosystem. Javaid et al., 2018 introduced a PUF and blockchain based arrangement called BlockPro for information provenance and information respectability for secure IoT conditions. M. Anwer et al.,2020 proposed course of action of different masters' procedures of Block chain to make IoT check and discussion about their limitations.

Authors in discussed various security pitfalls in encryption techniques used for different IoT solutions. Arbitrary number generators have generally been a critical wellspring of weakness .Stephen Checkoway et al.,2014 introduced the new PRNG algorithm. it was speedy. Yu et al., 2015 introduced distinctive known feeble gadgets to encounter DDOS attack. Zhang et al.,2015 showed by various authorities a noteworthy perspective in IoT landscape. Authorsin played out a wide

examination on the powerless IoT devices, including thousands of interesting contraptions. A large portion of them were transparently accessible by methods for the Internet requiring no unmistakable evidence.

A study sets out a short outline of the nuts and bolts Machine Learning and its standards and calculations Submissions. We'll begin with a more extensive machine definition Study and afterward consolidating various types of getting the hang of including Methods administered and uncontrolled, and profound learning Perfect standards. We'll examine usage in the remainder of the paper Machine learning calculations in various territories including design Recognition, sensor systems, identification of irregularities and the Internet ofThings (IoT), and checking of wellbeing.

Another study features a system that incorporates the Internet of Things (IoT) and some generally utilized AI calculations to make a prescient model that can be utilized to gauge indoor temperature of shrewd structures. This prescient model was prepared to build up practicality to a totally new dataset utilizing on-line learning system. To approve the methodology, the paper leads a Machine Learning put together test with respect to recorded genuine sensor data[131]. The paper at that point recommends that the accompanying procedure ought to be incorporated into an IoT design dependent on Edge Computing to empower the structure to work in a vitality productive manner.

III. SIGNIFICANCE & VALUE OF TOPIC

This section contains a brief description different application of IoT[132].

● Smart Healthcare
Incorporating IoT innovations with clinical gadgets help steady remote observing for patients and old individuals [134]. This unrest in treatment and conclusion of ailment improve the early recognizing of afflictions for instance pacemakers coordinated with IoT innovation take into account continuous information of patient's cardiovascular readings to be made accessible to clinical professionals. Permitting them to be quickly get relevant information if a

surprising heart action is identified by the IoT gadgets [135].

● Wearable Devices

It is little canny gadgets implanted with sensors and remote network utilized for wellbeing and movement observing like shrewd watches, wellness groups and brilliant glasses, which encourage individuals to screen their wellbeing and exercises for the duration of the day [136]. Other intriguing applications are for helping incapacitated individuals, for instance, the associated insoles which assist daze with peopling in route by giving them the bearings through detecting rather than screen route as their shoes vibrate to the ideal heading. Likewise, it is utilized for recognizable proof and security purposes like the distinguishing proof identifications, in any case, unapproved access to IoT wearable gadgets may make danger wellbeing like unapproved access to the associated insoles also, thinking about close to home protection, as these gadgets gather and store information which makes them an objective for aggressors and malwares.

● Smart Homes and Smart Cities

Smart home is transforming you normal home machines into keen and insightful gadgets empowering remote control and the executives of the framework through the web [137]. In smart homes appliances, for example, fridge, clothes washer, lights, air conditioners, web camera, door lock and so on can be remotely controlled making life less difficult and progressively agreeable [138]. Security breaks could be perilous, envision criminal hacks to the digital lock and enters home successfully. Also these gadgets continue recording your propensities, conduct, and exercises which could be a genuine danger to individual protection. In any case, such risk should be protected by following a proper risk mitigation plan.

● Smart Agriculture

With little sensors and actuators, farmers can screen the soil and yields wellbeing to have more harvest profitability, and keep up proficient utilization of assets like water at a lesser expense [139]. A superior comprehension of the plant development models and having the information ashore conditions and atmosphere fluctuation will essentially increment

horticultural efficiency by staying away from the wrong cultivating conditions. Security assaults on sensors or actuator on field compromising the corps creation, wrong detected information about the temperature, stickiness, soil dampness influences the water stream on irrigators which legitimately influence the harvests creation.

● Smart Transportation and Connected Cars

Intelligent infrastructure permits consistent correspondence between vehicles, cloud, and traffic checking place for more secure, helpful and progressively proficient travel. Smart transportation offers types of assistance, for example, traffic checking, live condition, traffic signal control, and real time navigation [140]. Be that as it may, in the vehicular system, vehicles are associated with one another in a specially appointed way. Every vehicle goes about as a hub in a system which can trade data by speaking with different vehicles (vehicle-to-vehicle) or speaks with the side-street canny framework for better dynamic and staying away from the congested driving conditions at times of heavy traffic.

● Energy Management

One of the significant objectives of IoT is better usage of energy and decreasing energy theft. By breaking down the information of energy we can recognize the key energy shoppers, feature energy wastage and give us capability to predict the energy demand [141]. A case of light at homes, avenues, and structures utilizing sensors these lights respond progressively to changes in the general condition in this way, we accomplish an extraordinary energy saving [142-144].

IV.   RESEARCH GAP

Following gaps are identified during literature survey:
● It is found that authentication is a real challenge in IoT. The fact behind this is that appropriate authentication infrastructure is not available in IoT .
● Distribution of keys is another challenge .
● Security is the biggest worry for most industries.

- Man in Middle assault is a serious problem because of the architecture .
- DDOS attack is also a major problem with IoT network. But a universal mitigation plan is not available.
- Vulnerability in IoT device is a dangerous issue. It is needed to be classified and predicted . Vulnerable device is a real threat to IoT network. Such Devices are required to be identified .

V. RESEARCH OBJECTIVES

- To identify security attributes of IoT
- To identify security threats and vulnerabilities related to Internet of Things.
- Design, implementation and validation of vulnerabilities classification and prediction model
- Development of block chain based remedial action plan to mitigate vulnerabilities in IOT network.

VI. PROPOSED METHODOLOGY & IMPLEMENTATION

The proposed methodology will comprise of three main phases. These phases are described in brief as follows:

Phase 1: Identification of information security threats in IoT network
A Systematic literature review will be conducted to identify different security threats , attacks and vulnerabilities in IoT .

Phase 2: Development of Vulnerability Classification and Prediction Model
we will develop a machine learning based classification model to classify and predict vulnerabilities. This will be implemented in Java. IoT-23 data set will be used [142].

Phase 3: Development of Vulnerability Mitigation Plan
we will propose a theoretical security model. This model will contain mitigation of all identified vulnerabilities using block chain, machine learning and some other techniques. This model will be compared theoretically with other models on the basis of some parameters.

REFERENCES

[1] B. Dorsemaine, J. Gaulier, J. Wary, N. Kheir and P. Urien, "Internet of Things: A Definition & Taxonomy," 2015 9th International Conference on Next Generation Mobile Applications, Services and Technologies, Cambridge, 2015, pp. 72-77, doi: 10.1109/NGMAST.2015.71.

[2] J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A vision, architectural elements, and future directions," Future Generation Computer Systems, vol. 29, no. 7, pp. 1645–1660, 2013.

[3] L. Atzori, A. Iera, and G. Morabito, "The Internet of Things: A survey," Computer Networks, vol. 54, no. 15, pp. 2787–2805, 2010.

[4] M. Mozaffari-Kermani, M. Zhang, A. Raghunathan, and N. K. Jha, "Emerging frontiers in embedded security," in Proc. IEEE Int. ConfVLSI Design, 2013, pp. 203–208.

[5] K. Su, J. Li, and H. Fu, "Smart city and the applications," in Proc. IEEE Int. Conf. Electronics, Communications and Control, 2011, pp. 1028–1031.

[6] M. T. Lazarescu, "Design of a WSN platform for long-term environmental monitoring for IoT applications," IEEE J. Emerging and Selected Topics in Circuits and Systems, vol. 3, no. 1, pp. 45–54, 2013.

[7] E. Fleisch, "What is the Internet of Things? An economic perspective," Economics, Management, and Financial Markets, no. 2, pp. 125–157, 2010.

[8] M. Tajima, "Strategic value of RFID in supply chain management," J. Purchasing and Supply Management, vol. 13, no. 4, pp. 261–273, 2007.

[9] Arsalan Mohsen Nia, Niraj K. Jha, Fellow, "A Comprehensive Study of Security of Internet of Things" , IEEE Transactions on Emerging Topics in Computing, 2016.

[10] Mohamed Abomhara, Geir M. Køien, "Security and Privacy in the Internet of Things: Current Status and Open Issues", IEEE Conference on Privacy and Security in Mobile Systems (PRISMS), 2014.

[11] Dolly Das, Bobby Sharma, "General Survey on Security Issues on Internet of Things", International Journal of computer Applications", vol 139, pp. 23-29, 2016.

[12] Salim ELBOUANANI, My Ahmed EL KIRAM, "Introduction To The Internet Of Things Security Standardization and research challenges", 11th International Conference on Information Assurance and Security, IEEE, pp 32-37, 2015.

[13] KrishnaKanth Gupta, SapnaShukla, "Internet of Things: Security Challenges for Next Generation Networks", 1st International Conference on Innovation and Challenges in Cyber Security, IEEE, pp. 315-318, 2016.

[14] Gurpreet Singh Matharu, PriyankaUpadhyay, LalitaChaudhary, "The Internet of Things: Challenges & Security Issues", International Conference on Emerging Trends, IEEE, pp. 54-59, 2014.

[15] HuiSuo, Jiafu Wan, "Security in the Internet of Things: A Review", International Conference on Computer Science and Electronics Engineering, IEEE, pp. 648-651, 2012.

[16] C. Flügel, and V. Gehrmann, "Scientific workshop 4: intelligent objects for the Internet of Things: Internet of Things-application of sensor networks in logistics," Communications in Computer and Information Science, vol.32, pp.16-26, 2009.

[17] L. Atzori, A. Iera, G. Morabito, and M. Nitti, "The social Internet of Things (SIoT) when social networks meet the Internet of Things: concept, architecture and network characterization," Computer Networks, vol.56, no.16, pp. 3594-3608, 2012.

[18] Hammi, Mohamed Tahar, et al. "Bubbles of Trust: A decentralized blockchain-based authentication system for IoT." Computers & Security 78 (2018): 126-142.

[19] Banerjee, Mandrita, Junghee Lee, and Kim-Kwang Raymond Choo. "A blockchain future for internet of things security: A position paper." Digital Communications and Networks 4.3 (2018): 149-160.

[20] Khan, Minhaj Ahmad, and Khaled Salah. "IoT security: Review, blockchain solutions, and open challenges." Future Generation Computer Systems 82 (2018): 395-411.

[21] Agrawal, Rahul, Pratik Verma, Rahul Sonanis, UmangGoel, Aloknath De, SaiAnirudhKondaveeti, and SumanShekhar. "Continuous security in IoT using Blockchain." In 2018 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), pp. 6423-6427. IEEE, 2018.

[22] Javaid, Uzair, Ang Kiang Siang, Muhammad NaveedAman, and BiplabSikdar. "Mitigating loT Device based DDoS Attacks using Blockchain." In Proceedings of the 1st Workshop on Cryptocurrencies and Blockchains for Distributed Systems, pp. 7176. ACM, 2018.

[23] Javaid, Uzair, Muhammad NaveedAman, and BiplabSikdar. "BlockPro: Blockchain based Data Provenance and Integrity for Secure IoT Environments." In Proceedings of the 1st Workshop on Blockchain-enabled Networked Sensor Systems, pp. 13-18. ACM, 2018.

[24] M. Anwer, A. saad and A. Ashfaque, "Security of IoT Using Block chain: A Review," 2020 International Conference on Information Science and Communication Technology (ICISCT), KARACHI, Pakistan, 2020, pp. 1-5, doi: 10.1109/ICISCT49550.2020.9079943.

[25] David Lazar, Haogang Chen, Xi Wang, and NickolaiZeldovich. Why does cryptographic software fail?: a case study and open problems. In APSys 2014, pages 7:1–7:7, 2014.

[26] Gregory V. Bard. The Vulnerability of SSL to Chosen Plaintext Attack. IACR Cryptology ePrintArchive, 2004:111, 2004.

[27] Ian Goldberg and David Wagner. Randomness and the Netscape browser. Dr

Dobb's Journal-Software Tools for the Professional Programmer, 21(1):66–71, 1996.

[28] Daniel J. Bernstein, Yun-An Chang, Chen-Mou Cheng, Li-Ping Chou, Nadia Heninger, Tanja Lange, and Nicko van Someren. Factoring RSA Keys from Certified Smart Cards: Coppersmith in the wild. In ASIACRYPT 2013, pages 341–360, 2013.

[29] Nadia Heninger, ZakirDurumeric, Eric Wustrow, and J. Alex Halderman. Mining your Ps and Qs: Detection of Widespread Weak Keys in Network Devices. In USENIX Security 2012, pages 205– 220, 2012.

[30] Stephen Checkoway, Ruben Niederhagen, Adam Everspaugh, Matthew Green, Tanja Lange, Thomas Ristenpart, Daniel J. Bernstein, Jake Maskiewicz, HovavShacham, and Matthew Fredrikson. On the practical exploitability of dual EC in TLS implementations. In USENIX Security 2014, pages 319–335, 2014.

[31] Stephen Checkoway, Jacob Maskiewicz, Christina Garman, Joshua Fried, ShaananCohney, Matthew Green, Nadia Heninger, RalfPhilippWeinmann, Eric Rescorla, and HovavShacham. A systematic analysis of the Juniper Dual EC incident. In ACM CCS 2016, pages 468–479, 2016.

[32] Yu, T., Sekar, V., Seshan, S., Agarwal, Y., and Xu, C. Handling a trillion (unfixable) flaws on a billion devices. Proceedings of the 14th ACM Workshop on Hot Topics in Networks - HotNets-XIV, ACM Press (2015), 1–7.

[33] Zhang, Z.-K., Cho, M.C.Y., and Shieh, S. Emerging Security Threats and Countermeasures in IoT. Proceedings of the 10th ACM Symposium on Information, Computer and Communications Security - ASIA CCS '15, ACM Press (2015), 1–6

[34] Patton, M., Gross, E., Chinn, R., Forbis, S., Walker, L., and Chen, H. Uninvited Connections: A Study of Vulnerable Devices on the Internet of Things (IoT). IEEE Joint Intelligence and Security Informatics Conference, IEEE (2014), 232–235.

[35] Airehrour, D., Gutierrez, J., and Ray, S.K. Secure routing for internet of things: A survey. JNCA66, (2016), 198–213.

[36] U. S. Shanthamallu, A. Spanias, C. Tepedelenlioglu and M. Stanley, "A brief survey of machine learning methods and their sensor and IoT applications," 2017 8th International Conference on Information, Intelligence, Systems & Applications (IISA), Larnaca, 2017, pp. 1-8, doi: 10.1109/IISA.2017.8316459.

[37] D. Paul, T. Chakraborty, S. K. Datta and D. Paul, "IoT and Machine Learning Based Prediction of Smart Building Indoor Temperature," 2018 4th International Conference on Computer and Information Sciences (ICCOINS), Kuala Lumpur, 2018, pp. 1-6, doi: 10.1109/ICCOINS.2018.8510597.

[38] Makransky, G., & Petersen, G. B. (2019). Investigating the process of learning with Desktop Virtual Reality: A structural equation modeling approach. Computers & Education, 134, 15–30. https://doi.org/10.1016/j.compedu.2019.02.002

[39] Velev, D., &Zlateva, P. (2017). Virtual reality challenges in education and training. International Journal of Learning and Teaching, 3(1), 33-37.

[40] Bazavan, L. C., Roibu, H., Petcu, F. B., Cismaru, S. I., & George, B. N. (2021, September). Virtual Reality and Augmented Reality in Education. In 2021 30th Annual Conference of the European Association for Education in Electrical and Information Engineering (EAEEIE) (pp. 1-4). IEEE.

[41] Tilhou, R., Taylor, V., & Crompton, H. (2020). 3D virtual reality in K-12 education: A thematic systematic review. Emerging technologies and pedagogies in the curriculum, 169-184.

[42] Simsek, I. (2016). The Effect of 3D Virtual Learning Environment on Secondary School Third Grade Students' Attitudes toward Mathematics. Turkish Online Journal of

Educational Technology (TOJET), 15(3), 162 - 168.

[43] Guerrero, G., Ayala, A., Mateu, J., Casades, L., &Alamán, X. (2016, October). Integrating Virtual Worlds with Tangible User Interfaces for Teaching Mathematics: A Pilot Study. Sensors, 16(11).

[44] Mateu, J., Lasala, M., &Alaman, X. (2014). VirtualTouch: A Tool for Developing Mixed Reality Educational Applications and an Example of Use for Inclusive Education. International Journal of Human-Computer Interaction, 30(10), 815-828.

[45] Heradio, R., de la Torre, L., Galan, D., Cabrerizo, F. J., Herrera-Viedma, E., &Dormido, S. (2016). Virtual and remote labs in education: A bibliometric analysis. Computers and Education, 14-38.

[46] Brinson, J. R. (2015). Learning outcome achievement in non-traditional (virtual and remote) versus traditional (handson) laboratories: A review of the empirical research. Computers & Education, 218-237.

[47] Sala, N. (2021). Virtual reality, augmented reality, and mixed reality in education: A brief overview. Current and prospective applications of virtual reality in higher education, 48-73.

[48] Bazavan, L. C., Roibu, H., Petcu, F. B., Cismaru, S. I., & George, B. N. (2021, September). Virtual Reality and Augmented Reality in Education. In 2021 30th Annual Conference of the European Association for Education in Electrical and Information Engineering (EAEEIE) (pp. 1-4). IEEE.

[49] Parker, J., & Heywood, D., (1998) The earth and beyond: Developing primary teachers' understanding of basic astronomical events. International Journal of Science Education, 20(5), 503-520.

[50] Pena, B. M., & Gil Quilez, M. J., (2021) The importance of images in astronomy education. International Journal of Science Education, 23(11), 1125-1135.

[51] Huang, H.-M., Rauch, U., &Liaw, S.-S., (2010). Investigating learners' attitudes toward virtual reality learning environments: Based on a constructivist approach. Computers & Education, 55, 1171–1182.

[52] Marsh, J., Plowman, L., Yamada-Rice, D., Bishop, J., Lahmar, J., & Scott, F., (2018) Play and creativity in young children's use of apps. British Journal of Educational Technology, 49(5), 870-882.

[53] Kaminska, D.; Sapinski, T.; Wiak, S.; Tikk, T.; Haamer, R.; Avots, E.; Anbarjafari, G., (2019). Virtual Reality and Its Applications in Education: Survey. Information, 10, 318.

[54] Mandal, S., (2013). Brief introduction of virtual reality & its challenges. Int. J. Sci. Eng. Res. 4, 304–309

[55] Obeidat, H.; Meccawy, M.; Blanchfield, P., (2009). Authoring for Adaptive Web-Based Learning Systems: A Case Study; International Journal of Emerging Technology in Learning: Kassel, Germany.

[56] Rey-López, M.; Brusilovsky, P.; Meccawy, M.; Díaz-Redondo, R.; Fernández-Vilas, A. (2008). Ashman, H. Resolving the problem of intelligent learning content in learning management systems. Int. J. E-Learn.

[57] Velev, D. &Zlateva, P., (2017). Virtual reality challenges in education and training. Int. J. Learn. Teach., 3, 33–37

[58] Alalwan, N.; Cheng, L.; Al-Samarraie, H.; Yousef, R.; Alzahrani, A.I.; Sarsam, S., (2020). Challenges and prospects of virtual reality and augmented reality utilization among primary school teachers: A developing country perspective. Stud. Educ. Eval., 66, 100876.

[59] R. H. von Alan, S. T. March, J. Park, and S. Ram, (2004). Design science in information systems research, MIS quarterly, vol. 28, no. 1, pp. 75–105.

[60] JAWARNEH, M. (2022). The Effects of Reducing Food Waste on Increasing the Quality of a Healthy Life.

[61] Ahad, M. A., Paiva, S., &Zafar, S. (2020). Sustainable and Energy Efficient Computing Paradigms for Society. Springer International Publishing AG.

[62] Al-Ahmad, A., Ahmaro, I. Y., & Mustafa, M. (2017). E-learning Difficulties in Jordan. MEDIU publications, 1(5).

[63] Al-Ahmad, A., Ahmaro, I. Y., & Mustafa, M. (2017). Importance of UML model in the RUP Development lifecycle along with the time and the static aspect of the process. Al-Madinah Technical Studies, 1(4).

[64] Li Yan, MohdWazih Ahmad, Malik Jawarneh, Mohammad Shabaz, R. Raffik, KakarlaHari Kishore, "Single-Input Single-Output System with Multiple Time Delay PID Control Methods for UAV Cluster Multiagent Systems", Security and Communication Networks, vol. 2022, Article ID 3935143, 7 pages, 2022. https://doi.org/10.1155/2022/3935143

[65] Al-Ahmad, A., Ahmaro, I. Y., & Mustafa, M. Classifying Disease Related Data Sets and Building a System for predicting and diagnosing Such Diseases Us-ing Decision Tree Mining Algorithm.

[66] Al-Ahmad, A., Ahmaro, I., & Mustafa, M. (2015). Comparison between web accessibility Evaluation tools. AlMadinah Technical Studies, 1(4).

[67] Alkhatib, K., Al-Aiad, A., Mustafa, M., &Alzubi, S. (2021). Impact factors affecting entrepreneurial intention of Jordanian private universities students: a mediation analysis of perception toward entrepreneurship. In Sustainable and Energy Efficient Computing Paradigms for Society (pp. 53-65). Springer, Cham.

[68] Huo, Z., Luo, X., Wang, Q., Jagota, V., Jawarneh, M. and Sharma, M., 2022. Design and simulation of vehicle vibration test based on virtual reality technology. Nonlinear Engineering, 11(1), pp.500-506.

[69] Al-Mushasha, N. F., & Hassan, S. (2009). A model for mobile learning service quality in university environment. International Journal of Mobile Computing and Multimedia Communications (IJMCMC), 1(1), 70- 91.

[70] Jawarneh, M.M., 2022. Factors affecting the success of VR-learning implementation in institutes of higher learning in Jordan.

[71] Alshar'e, M., & Mustafa, M. (2021). Evaluation of autistic children's education in Oman: the role of eLearning as a major aid to fill the gap. Elementary Education Online, 20(5), 5531-5540.

[72] Alshar'e, M.I., R. Sulaiman, M.R. Mokhtar and A. MohdZin, 2014. Design and implementation of the TPM user authentication model. J. Comp. Sci., 10: 2299-2314. DOI: 10.3844/jcssp.2014.2

[73] Alshar'e, M.I., R. Sulaiman, M.R. Mukhtar and A.M. Zin, 2014. A user protection model for the trusted computing environment. J. Comput. Sci., 10: 1692-1702. DOI: 10.3844/jcssp.2014.1692.1702.

[74] Alshar'E, Marwan, Abdullah MohdZin, RossilawatiSulaiman, and MohdRosmadiMokhtar, 2015 "Evaluation of the TPM user authentication model for trusted computers." Journal of Theoretical and Applied Information Technology 81(2): 298-309.

[75] Alzubi, F., & Mustafa, M. (2021). Critical Review of A Recent and Significant Change in the (Primary Health Care Center) in Lights of Thr Contemporary Reserch and Best Practice.

[76] Arshad, H., Mustafa, M., &BadiozeZaman, H. (2015). Design of Vibratory Haptic Interface Model (VHIM) for Autistic Children's Social Interaction. Asian Journal of Information Technology, 14(3), 111-116.

[77] Arumugam, K., Swathi, Y., Sanchez, D. T., Mustafa, M., Phoemchalard, C., Phasinam, K., &Okoronkwo, E. (2021). Towards applicability of machine learning techniques in agriculture and energy sector. Materials Today: Proceedings.

[78] Bhola, J., Jeet, R., Jawarneh, M. M. M., &Pattekari, S. A. (2021). Machine Learning Techniques for Analysing and Identifying Autism Spectrum Disorder. In Artificial Intelligence for Accurate Analysis and Detection of Autism Spectrum Disorder (pp. 69-81). IGI Global.

[79] BIO-CELL CULTURE PROCESSES IN REAL-TIME MONITORING APPROACH

WITH MACHINE LEARNING TECHNIQUES.NAGALAKSHMI.T, MAMTA SHARMA , MALIK MUSTAFA MOHAMMAD , ZATIN GUPTA , ASHISH KUMAR TAMRAKAR , AND BESLIN GEO.V.

[80] Brahmi, B., & Mustafa, M. (2019). Impact of Knowledge Management Process on Managerial Performance in the High Tech Sector. International Journal of Business and Management, 14(2).

[81] Bsoul, Q., Abdul Salam, R., Atwan, J., &Jawarneh, M. (2021). Arabic Text Clustering Methods and Suggested Solutions for Theme-Based Quran Clustering: Analysis of Literature. Journal of Information Science Theory and Practice, 9(4), 15-34.

[82] Chakraborty, C., Banerjee, A., Garg, L., & Rodrigues, J. J. (2020). Internet of Medical Things for Smart Healthcare. Studies in Big Data; Springer: Cham, Switzerland, 80.

[83] Chen, H. J. (2010). Linking employees'e-learning system use to their overall job outcomes: An empirical study based on the IS success model. Computers & Education, 55(4), 1628-1639.

[84] Cordova, R.S., Maata, R.L.R., Epoc, F.J. and Alshar'e, M., 2021. Challenges and Opportunities of Using Blockchain in Supply Chain Management. Global Business and Management Research: An International Journal , pp. 204-217, 13(3).

[85] "Bio-Cell Culture Processes in Real-Time Monitoring Approach with Machine Learning Techniques." International Journal of Biology, Pharmacy and Allied Sciences, vol. 10, no. 11 (SPECIAL ISSUE), 2021, https://doi.org/10.31032/ijbpas/2021/10.11.10 44.

[86] Zhao, Wei, et al. "Design of Die-Casting Die for Engine Cylinder Head Based on 3D Printing and Genetic Algorithm." Computer-Aided Design and Applications, 2022, pp. 190–199., https://doi.org/10.14733/cadaps.2023.s3.190-199.

[87] Mustafa, Malik, et al. "Multitask Learning for Security and Privacy in Iov (Internet of Vehicles)." Autonomous Vehicles Volume 1, 2022, pp. 217–233., https://doi.org/10.1002/9781119871989.ch12.

[88] DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: a ten-year update. Journal of management information systems, 19(4), 9-30.

[89] Franklin, D. L. (2009). What Kind of Business-Friendly Court-Explaining the Chamber of Commerce's Success at the Roberts Court. Santa Clara L. Rev., 49, 1019.

[90] Heo, J., & Han, I. (2003). Performance measure of information systems (IS) in evolving computing environments: an empirical investigation. Information & management, 40(4), 243-256.

[91] Jawarneh, M. M. (2008). Web-Based Patient Medical Record History (Doctoral dissertation, Universiti Utara Malaysia).

[92] Kassanuk, T., Mustafa, M., &Panse, P. (2021). An Internet of Things and Cloud Based Smart Irrigation System. Annals of the Romanian Society for Cell Biology, 20010-20016.

[93] Kollu, P. K. (2021). Blockchain Techniques for Secure Storage of Data in Cloud Environment. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12(11), 1515-1522.

[94] Kuthadi, V. M., Selvaraj, R., Rao, Y. V., Kumar, P. S., Mustafa, M., Phasinam, K., &Okoronkwo, E. TOWARDS SECURITY AND PRIVACY CONCERNS IN THE INTERNET OF THINGS IN THE AGRICULTURE SECTOR. Turkish Journal of Physiotherapy and Rehabilitation, 32(3).

[95] McGarry, D., Cashin, A., & Fowler, C. (2011). "Coming ready or not" high fidelity human patient simulation in child and adolescent psychiatric nursing education: Diffusion of innovation. Nurse Education Today, 31(7), 655-659.

[96] Mustafa, M. (2021). Coping with and Analysing Factors Impacting Omani Colleges Students' Entrepreneurial Intent during Covid-19 Pandemic. Turkish Journal of Computer

and Mathematics Education (TURCOMAT), 12(11), 7019-7031.

[97]   Mustafa, M. Y., Hassan, S. S., & Ahmad, M. D. (2007). Frequency of occurrence of mastitis in different quarters of udders and its cure-a field study. Biologia, 53, 51-57.

[98]   Mustafa, M., & Abbas, A. (2021). comparative analysis of green ict practices among palestinian and malaysian in sme food enterprises during covid-19 pandemic. PalArch's Journal of Archaeology of Egypt/Egyptology, 18(4), 254-264.

[99]   Mustafa, M., & Al-Badi, A. (2021). Role of Internet of Things (IoT) Increasing Quality Implementation in Oman Hospitals During Covid-19. SPAST Abstracts, 1(01).

[100] Mustafa, M., &Alzubi, S. (2020). Factors affecting the success of internet of things for enhancing quality and efficiency implementation in hospitals sector in Jordan during the crises of Covid-19. In Internet of Medical Things for Smart Healthcare (pp. 107-140). Springer, Singapore.

[101] Mustafa, M., Abbas, A., Bsoul, Q., &Shabbir, A. (2021). Smart Irrigation System Based on the Internet of Things and the Cloud.

[102] Mustafa, M., Alshare, M., Bhargava, D., Neware, R., Singh, B., &Ngulube, P. (2022). Perceived Security Risk Based on Moderating Factors for Blockchain Technology Applications in Cloud Storage to Achieve Secure Healthcare Systems. Computational and Mathematical Methods in Medicine, 2022.

[103] Mustafa, M., Alshar'e, M., Shariah, A., Al-Alawi, M., & Mohammad, A. (2021). Managing and analyzing factors influencing Saudi college students' entrepreneurial intention during the Covid-19 pandemic. Turkish Journal of Physiotherapy and Rehabilitation, 7486-7496.

[104] Mustafa, M., Alzubi, F. K., &Bashayreh, A. (2021). Factors Affecting Job Performance of Teaching and NonTeaching Staff in Higher Education Levels in Oman. Ilkogretim Online, 20(5).

[105] Mustafa, M., Alzubi, S., &Alshare, M. (2020, April). The Moderating Effect of Demographic Factors Acceptance Virtual Reality Learning in Developing Countries in the Middle East. In International Conference on Advances in Computing and Data Sciences (pp. 12-23). Springer, Singapore.

[106] Mustafa, M., Arshad, H., &Zaman, H. B. (2013, December). Framework Methodology of the Autism Children-- Vibratory Haptic Interface (AC-VHI). In 2013 International Conference on Advanced Computer Science Applications and Technologies (pp. 201-206). IEEE.

[107] Mustafa, M., Virmani, D., Kaliyaperumal, K., Phasinam, K., &Santosh, T. (2021). Towards Investigation of Various Security And Privacy Issues In Internet Of Things. Design Engineering, 1747-1758.

[108] Najar, F., Bourouis, S., Alshar'e, M., Alroobaea, R., Bouguila, N., Al Badi, A. H., &Channoufi, I. (2020, September). Efficient Statistical Learning Framework with Applications to Human Activity and Facial Expression Recognition. In 2020 5th International Conference on Advanced Technologies for Signal and Image Processing (ATSIP) (pp. 1- 6). IEEE.

[109] SurindarGopalraoWawale, Malik Jawarneh, P. Naveen Kumar, Thomas Felix, JyotiBhola, Roop Raj,SathyapriyaEswaran, RajasekharBoddu, "Minimizing the Error Gap in Smart Framing by Forecasting Production and Demand Using ARIMA Model", Journal of Food Quality, vol. 2022, Article ID 1139440, 9 pages, 2022. https://doi.org/10.1155/2022/1139440 [46] MUSTAFA, MALIK. "Impact Factors of Smart Technology in Small and Medium Enterprises." (2021).

[110] Nielsen, S. E., Johnson, C. J., Heard, D. C., & Boyce, M. S. (2005). Can models of presence-absence be used to scale abundance? Two case studies considering extremes in life history. Ecography, 28(2), 197-208.

[111] Pallathadka, H., Mustafa, M., Sanchez, D. T., Sajja, G. S., Gour, S., &Naved, M. (2021). Impact of machine learning on management,

healthcare and agriculture. Materials Today: Proceedings.

[112] Petter, S., DeLone, W., & McLean, E. (2008). Measuring information systems success: models, dimensions, measures, and interrelationships. European journal of information systems, 17(3), 236-263.

[113] Mustafa, M., 2021. Impact of Digital Strategy in Business for Small and Medium Enterprises in Developing Countries. [51] Piercy, N., Phillips, W., & Lewis, M. (2013). Change management in the public sector: the use of cross-functional teams. Production Planning & Control, 24(10-11), 976-987.

[114] Sajja, G. S., Mustafa, M., Ponnusamy, R., &Abdufattokhov, S. (2021). Machine Learning Algorithms in Intrusion Detection and Classification. Annals of the Romanian Society for Cell Biology, 25(6), 12211-12219.

[115] Seddon, P. B. (1997). A respecification and extension of the DeLone and McLean model of IS success. Information systems research, 8(3), 240-253.

[116] Shabaz, M., Singla, P., Jawarneh, M. M. M., &Qureshi, H. M. (2021). A Novel Automated Approach for Deep Learning on Stereotypical Autistic Motor Movements. In Artificial Intelligence for Accurate Analysis and Detection of Autism Spectrum Disorder (pp. 54-68). IGI Global.

[117] Mustafa, Malik. "Impact of Information Technology on the Banking Sector in Developing Countries." (2021).

[118] SINGHAL, MANMOHAN, SATHISH KUMAR PENCHALA, and DHEERAJ RANE. "STUDY ON NETWORK MODEL ON TRANSMISSION OF INFECTIOUS DISEASES IN HOSPITALS."

[119] Tella, A. (2011). Reliability and factor analysis of a blackboard course management system success: A scale development and validation in an educational context. Journal of Information Technology Education: Research, 10(1), 55-80.

[120] MUSTAFA, MALIK. "The Effect of Using M-Banking System Approach in Small and Medium Enterprises." (2021). [62] Wang, Y.

S., Wang, H. Y., &Shee, D. Y. (2007). Measuring e-learning systems success in an organizational context: Scale development and validation. Computers in Human Behavior, 23(4), 1792-1808.

[121] Mustafa, Malik. "The technology of mobile banking and its impact on the financial growth during the covid-19 pandemic in the gulf region." Turkish Journal of Computer and Mathematics Education (TURCOMAT) 12, no. 9 (2021): 389-398.

[122] Gao, Huixian, Ahmed Kareem, Malik Jawarneh, Isaac Ofori, R. Raffik, and KakarlaHari Kishore. "Metaheuristics Based Modeling and Simulation Analysis of New Integrated Mechanized Operation Solution and Position Servo System." Mathematical Problems in Engineering 2022 (2022).

[123] MUSTAFA, M., 2021. Mobile Banking as Technology Adoption and Challenges. [66] Wawale, SurindarGopalrao, Malik Jawarneh, P. Naveen Kumar, Thomas Felix, JyotiBhola, Roop Raj, SathyapriyaEswaran, and RajasekharBoddu. "Minimizing the Error Gap in Smart Framing by Forecasting Production and Demand Using ARIMA Model." Journal of Food Quality 2022 (2022).

[124] Mustafa M. The Adoption of Mobile Banking Services in Jordanian Banks and Factors Affecting the Customers. ECS Transactions. 2022 Apr 24;107(1):2483.

[125] Mustafa, Malik, and O. A. A. J. Aldein. "Examining Perception of Malaysian autistic children social interaction for Virtual Reality." Zenodo, Dec-2020.

[126] Smail, B., Sanchez, D.T., PeconcilloJr, L.B., De Vera, J.V., Horteza, A.D. and Jawarneh, M., 2022. Investigating different applications of Internet of Things towards identification of vulnerabilities, attacks and threats. International Journal of Next-Generation Computing, 13(3).

[127] Zhao, W., He, C., Gill, R.,Jawarneh, M., &Shabaz, M. (2022). Design of die-casting die for engine cylinder head based on 3D printing and genetic algorithm. Computer-Aided

Design and Applications, 190-199. doi:10.14733/cadaps.2023.s3.190-199

[128] Alshar'e, M., Albadi, A., Jawarneh, M., Tahir, N. and Al Amri, M., 2022. Usability evaluation of educational games: an analysis of culture as a factor Affecting children's educational attainment. Advances in Human-Computer Interaction, 2022.

[129] Nageswaran, S., Arunkumar, G., Bisht, A.K., Mewada, S., Kumar, J.N.V.R., Jawarneh, M. and Asenso, E., 2022. Lung cancer classification and prediction using machine learning and image processing. BioMed Research International, 2022.

[130] Ansari, A.S., Jawarneh, M., Ritonga, M., Jamwal, P., Mohammadi, M.S., Veluri, R.K., Kumar, V. and Shah, M.A., 2022. Improved Support Vector Machine and Image Processing Enabled Methodology for Detection and Classification of Grape Leaf Disease. Journal of Food Quality, 2022.

[131] Olayah, F., Anaam, E. A., Bakhtan, M. A., Shamsan, A., Al Mudawi, N., Alazeb, A., ...&Jawarneh, M. (2022). Online Security on E-CRM System. Telematique, 7427-7443.

[132] Olayah, F., Anaam, E. A., Yahya, A. A., Hamdi, M., Shamsan, A., Ali, Y. A. A., ...&Jawarneh, M. (2022). A Systematic Literature Review for Multiple-Criteria Decision-Making Approaches in E-CRM Software. Telematique, 7444-7467.

[133] JAWARNEH, M. (2022). An Enhanced UTAUT Framework for Students Perception on Acceptance of Educational Games.

[134] Alshar'e, M., Mustafa, M., &Bsoul, Q. (2022). Evaluation of E-Learning Method as a Mean to Support Autistic Children Learning in Oman. Journal of Positive School Psychology, 6(3), 3040-3048.

[135] Jawarneh, M., Alshare, M., Bsoul, Q., &Kalash, H. S. The Impact of Machine Learning On Educational Institutions: An Empirical Study.

[136] Bian, L., Chen, J., Soni, M., Bhola, J., Kumar, H., &Jawarneh, M. (2022). Research on computer 3D image encryption processing based on the nonlinear algorithm. Nonlinear Engineering, 11(1), 664-671.

[137] Jawarneh, M. M. (2022). Factors affecting the success of VR-learning implementation in institutes of higher learning in Jordan. benefits, 10.

[138] SINGHAL, M., PENCHALA, S. K., & RANE, D. STUDY ON NETWORK MODEL ON TRANSMISSION OF INFECTIOUS DISEASES IN HOSPITALS.

[139] JAWARNEH, M., & SHARIAH, A. (2023). A Study on Effect of Virtual Reality Learning On Students: Usage on Classrooms. simulation, 16, 25.

[140] Malik Jawarneh, Marwan Alshar'e, DeshintaArrovaDewi, Mohammad Al Nasar, RashaAlmajed, Amer Ibrahim, "The Impact of Virtual Reality Technology on Jordan's Learning Environment and Medical Informatics among Physicians", International Journal of Computer Games Technology, vol. 2023, Article ID 1678226, 9 pages, 2023. https://doi.org/10.1155/2023/1678226

[141] Raghuvanshi, A., Singh, U., Sajja, G., Pallathadka, H., Asenso, E., & Kamal, M. et al. (2022). Intrusion Detection Using Machine Learning for Risk Mitigation in IoT-Enabled Smart Irrigation in Smart Farming. Journal Of Food Quality, 2022, 1-8. doi: 10.1155/2022/3955514

[142] Hemamalini, V., Rajarajeswari, S., Nachiyappan, S., Sambath, M., Devi, T., Singh, B., &Raghuvanshi, A. (2022). Food Quality Inspection and Grading Using Efficient Image Segmentation and Machine Learning-Based System. Journal Of Food Quality, 2022, 1-6. doi: 10.1155/2022/5262294

[143] Raghuvanshi, A., Singh, U., & Joshi, C. (2022). A Review of Various Security and Privacy Innovations for IoT Applications in Healthcare.Advanced Healthcare Systems, 43-58.doi: 10.1002/9781119769293.ch4

[144] V. Durga Prasad Jasti, Abu SarwarZamani, K. Arumugam, MohdNaved, HarikumarPallathadka, F. Sammy, AbhishekRaghuvanshi,

KarthikeyanKaliyaperumal, "Computational Technique Based on Machine Learning and Image Processing for Medical Image Analysis of Breast Cancer Diagnosis", Security and Communication Networks, vol. 2022, Article ID 1918379, 7 pages, 2022. https://doi.org/10. 1155/2022/1918379

[145] SushovanChaudhury, Alla Naveen Krishna, Suneet Gupta, K. SakthidasanSankaran, Samiullah Khan, KartikSau, AbhishekRaghuvanshi, F. Sammy, "Effective Image Processing and Segmentation-Based Machine Learning Techniques for Diagnosis of Breast Cancer", Computational and Mathematical Methods in Medicine, vol. 2022, Article ID 6841334, 6 pages, 2022. https://doi.org/10. 1155/2022/6841334

[146] Abu SarwarZamani, L. Anand, KantilalPitambarRane, P. Prabhu, Ahmed MateenButtar, HarikumarPallathadka, AbhishekRaghuvanshi, Betty NokobiDugbakie, "Performance of Machine Learning and Image Processing in Plant Leaf Disease Detection", Journal of Food Quality, vol. 2022, Article ID 1598796, 7 pages, 2022. https://doi.org/10. 1155/2022/1598796

[147] R. Veluri et al., "Learning analytics using deep learning techniques for efficiently managing educational institutes", Materials Today: Proceedings, vol. 51, pp. 2317-2320, 2022. Available: 10.1016/j.matpr.2021.11.416

[148] AbhishekRaghuvanshi, Umesh Kumar Singh , Dr. PrashantPanse, Monika Saxena, "A Taxonomy of Various Building Blocks of Internet of Things", International Journal of Future Generation Communication and Networking Vol. 13, No. 4, (2020), pp. 4397–4404

[149] AbhishekRaghuvanshi, Umesh Kumar Singh , Chetan Bulla , Dr. Monika Saxena, KishoriAbadar, "An Investigation on Detection of Vulnerabilities in Internet of Things", European Journal of Molecular & Clinical Medicine Volume 07, Issue 10, 2020, pp. 3289–3299

[150] AbhishekRaghuvanshi, Dr. Umesh Kumar Singh, PrashantPanse, Monika Saxena, Ravi Kishore Veluri , "Internet of Things: Taxonomy of Various Attacks", European Journal of Molecular & Clinical Medicine, 2020, Volume 7, Issue 10, Pages 3853-3864.

[151] A. Raghuvanshi, U. Singh, T. Kassanuk and K. Phasinam, "Internet of Things: Security Vulnerabilities and Countermeasures", ECS Transactions, vol. 107, no. 1, pp. 15043-15052, 2022. Available: 10.1149/10701.15043ecst.

[152] Raghavendra, S., Dhabliya, D., Mondal, D., Omarov, B., Sankaran, K. S., Dhablia, A., ...&Shabaz, M. (2022). Development of intrusion detection system using machine learning for the analytics of Internet of Things enabled enterprises. IET Communications.

[153] UmaMaheswaran, S. K., Prasad, G., Omarov, B., Abdul-Zahra, D. S., Vashistha, P., Pant, B., &Kaliyaperumal, K. (2022). Major Challenges and Future Approaches in the Employment of Blockchain and Machine Learning Techniques in the Health and Medicine. Security and Communication Networks, 2022.